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THE PROJECT MANAGEMENT ROLE IN SAFETY

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16. ABSTRACT

Techniques to be utilized by project management in the planning, implementation, and administration of a project safety program are presented.

Safety functional responsibilities are classified into two categories: safety management and safety engineering. The emphasis in this document is the safety management role, and how safety activities are to be integrated throughout the project and made visible in the work breakdown structure and cost accounting and reporting. Safety inputs into the RFP, contractor program plans, etc., constitute an effective method of safety achievement.

The project manager must provide for and have visibility into systematic identification and control of hazards.

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SECTION I. INTRODUCTION

The tragedy of the Apollo fire at Kennedy Space Center January 27, 1967, led to realization of the need for a more active safety program in NASA. Policies were dictated by Congress and by the NASA Administrator for a strong system safety program. The Aerospace Safety Advisory Panel was established by an Act of Congress in 1967 to assure that safety was adequately provided for in NASA programs. The charter for the Safety Advisory Panel provides strong requirements for the achievement of safety through program management and systems engineering processes. At the same time, the NASA Administrator placed top level emphasis on safety. The responsibility for safety clearly rests with NASA management and specifically with program management [1].

In the space program, we have to accept the premise that no system is ever absolutely risk-free, and that there are certain risks inherent in every system; therefore, it becomes an absolute necessity that all program managers know and understand the risks they are assuming. Through the establishment of his safety program, each program manager must assure that his planning and control systems are sufficiently formalized to develop the necessary level of risk visibility and to provide the means for effectively eliminating or controlling hazards. This is no easy task. Hazard identification requires inputs from practically every type of technologist. For example, hazards associated with aerodynamic pressure distribution can best be recognized by aerodynamic engineers, but it is the program manager who must assure that such recognitions, by many diverse specialists, are brought together into a project-wide hazard identification and risk management system.

The purpose of this technical memorandum is to reference and provide information, to give guidelines, and finally to make recommendations on the program management aspects of safety. System safety management is not an entirely new safety discipline. Rather, it is a logical and cost-effective approach to attaining and integrating a well-rounded hazard identification, prioritization and control program.

The material presented here is intended to serve as a guideline for establishment of contractor program management systems, as well as for MSFC program management. Many of the ideas and concepts on safety management that are presented here embody those derived from discussion with Dr. L. W. Ball, Director, Safety and Manned Flight Awareness Office, MSFC.

SECTION II. OBJECTIVES

System safety is a discipline oriented toward a total system that functions to identify and control all hazards or out-of-sequence events which, should they occur within the launch vehicle system during design, manufacture, handling, transportation, storage, test or operational activities, would cause loss to the system, the mission, or the crew. To perform these functions requires a significant amount of attention from the technical disciplines of engineering, manufacturing, test and product support, and from project management. This study was devoted primarily to the role of project management in attaining a viable and cost-effective safety program.

The objectives of this study are given in the following paragraphs.

The information presented here is to provide means for a project manager to assure himself that safety principles are adhered to and that adequate safety requirements are established and complied with. Safety is a principal concern of the project manager, and he must take positive steps to implement the necessary activities and disciplines to achieve safety in his project. Responsibility must be placed on pertinent personnel and managers with adequate provisions for hazard visibility and risk management through reports, meetings and maintenance of the status of project hazard control actions in the project control room.

An objective of this memorandum is to reaffirm that safety is a project management function and responsibility as well as an engineering function and responsibility. It is the project manager who makes the final decision on a particular risk, and he must have adequate support information available to help him make a logical and correct decision.

A technique for levying safety requirements and guidelines in the RFP is proposed, and methods of integrating safety activities will be suggested. The inclusion of safety segments in program plans is an effective management tool for obtaining visibility of safety and for integrating the safety activities.

In the event that it is not possible to include all the desired safety requirements for safety management inputs in the RFP, this technical memorandum may serve as a guidelines document at the discretion of the project manager for the contractor's use in preparing his proposal.

SECTION III. RESPONSIBILITIES

To ensure safety to personnel, hardware, facilities, etc., in any project, everyone involved must accept responsibility for safety, abiding by safety requirements and observing good safety work practicies. An individual operating a lathe or other machine tool is responsible, as is his supervisor, who must make his subordinate aware of hazards and safety requirements and who must ensure that safety requirements are not violated. The ultimate responsibility for safety lies with the project manager and with the managers of the basic functions: engineering, manufacturing, product support, and test.

In References 1 through 4, system safety is identified as a functional responsibility in two management areas: system safety management and system safety engineering. Extracts from these referenced documents are given here because they are very pertinent to the treatment of the subject of safety management:

Reference 1, NASA Safety Manual, vol. 3, par. 3102:

> 2. The decision on whether to assume a risk is clearly a program management responsibility. This decision is no better than the quality of the risk data that serves as a basis for the decision. Accordingly, the development of hazard and risk data should be assigned as a responsibility to professionals whose training and orientation cause them to search out and find the hazards in the system before these hazards manifest themselves in terms of damaged or destroyed hardware.

Reference 2, Basic Policy on Safety, NPD 1701. 1A:

> 3. BACKGROUND
>
> The actions and decisions which are required to achieve safety are virtually inseparable from program planning, management, and direction; and the steps

necessary to achieve safety of operations begin with initial planning and research and extend through every facet of NASA's activities.

.... every manager .... is responsible for systematically identifying risks and hazards or unsafe situations or practices, and for taking steps to assure safety in the activities and products under his supervision.

5. BASIC MANAGEMENT RESPONSIBILITIES

b. Institutional and program directors are responsible for implementing, within their areas of responsibility, a safety program which is consistent with established NASA safety policies, standards, and procedures.

NASA contractors usually have had experience with military programs, and as a result they are familiar with and respond to MIL-STD-882. It will be shown later that NASA policy is to utilize the contractor's system for safety insofar as is possible. The contractor's system very likely is already consistent with MIL-STD-882. MIL-STD-882 is particularly clear in the duality: safety management and safety engineering.

Reference 3, MIL-STD-882:

FOREWORD

The degree of safety achieved in a military system is directly dependent upon management emphasis. Management emphasis on safety must be applied by the government and contractors during the conception, development, production, and operation of each military system.

The results of the system safety effort is dependent upon the procuring agency clearly stating safety objectives and requirements, and the contractor's ability to translate these into functional hardware.

Par. 3.4 System safety management.

> An element of program management which insures the accomplishment of the system safety tasks, including identification of the system safety requirements; planning, organizing, and controlling those efforts which are directed toward achieving the safety goals; coordinating with other (system) program elements; and analyzing, reviewing, and evaluating the program to insure effective and timely realization of the system safety objectives.

Par. 3.5 System safety engineering.

> An element of systems engineering involving the application of scientific and engineering principles for the timely identification of hazards and initiation of those actions necessary to prevent or control hazards within the system. It draws upon professional knowledge and specialized skills in the mathematical, physical, and related scientific disciplines, together with the principles and methods of engineering design and analysis to specify, predict, and evaluate the safety of the system.

Because of their experience with military programs, the contractors should be accustomed to this distinction between the complementary but different functions of duality of safety management and safety engineering. Knowledge of this fact should enable a NASA program manager to more readily capitalize on the contractor's capability in the area of safety.

The importance of this duality is further emphasized in Reference 4, a letter from the MSFC Safety Director to the MSFC Shuttle Program Manager, extracted as follows:

> SYSTEM SAFETY MANAGEMENT
>
> The system safety management responsibility requires use of program management techniques and program management authority to assure that system safety critical activities are required, scheduled, funded, and that their performance is audited and the results

made visible to both contractor and customer program management. It includes adequate display of safety status data in program control rooms and adequate reporting and followup on action assignments at program review meetings.

SYSTEM SAFETY ENGINEERING

System safety engineering is an element of systems engineering. It requires the performance of hazard identification and hazard control evaluation analysis, the preparation of project hazard summaries, and the integration of safety analysis requirements and data into systems engineering documentation and into trade studies and the design decision-making process.

The extracts quoted above are included to provide an authoritative basis for distinct responsibilities for safety in both management and engineering. It will be emphasized in later paragraphs that safety activities must be integrated throughout the project or program, that adequate hazard analyses should be carried out by appropriate technical disciplines, and that ample provisions should be made for visibility by top-level management of the hazards and potential risks that exist in the program.

SECTION IV. MANAGEMENT ASPECTS OF ACHIEVING SAFETY

During recent years greater emphasis has been directed toward the achievement of safety, especially system safety; and certain means have evolved, and are continuing to evolve, to meet safety objectives. Realistically establishing and achieving safety objectives in any project requires the attention and support of management. The requirements for an effective safety program must be established and implemented at the program or project management level, and these requirements are a pertinent part of program management planning and activities. Various mechanics and tools of program management are available to be utilized to assure that the safety objectives are achieved through the authority and techniques of program management. Typical program management tools that are very readily adaptable to this end are listed as follows:

1. Project Planning
2. Request for Proposal (RFP)
3. Statement of Work (S/W)
4. Data Requirements List (DRL)
5. Organizing
6. Safety Program Plan
7. Risk Management Report
8. Technical and Administrative Management Plans
9. Interface Management
10. Work Breakdown Structure (WBS)
11. Performance Measurement System
12. Configuration Management System
13. Specifications and Procedures
14. Milestone Review Meetings

The critical activity system offers a unique approach to achieving effective management and for integrating desired product characteristics into the end item. Critical activities are those activities that experience has shown make a significant contribution to the confidence that essential product characteristics will be achieved. The product characteristics include safety, as well as maintainability, reliability, quality, and other desired features. Through a process of evaluation, optimization, and decision-making, the program manager must designate those activities to be pursued in the endeavor and provide resources in the form of organizational entities and funding. Subtiered under critical activities are subactivities and techniques. Engineers who specialize in one or more activities or subactivities become expert in implementing them and making appropriate inputs into the right places at the right time. Program specifications and program plans identify these activities and make provisions for their implementation, and thus they become valuable tools in the hands of management. Critical activities also form a basis for inputs into the performance measurement system. The performance measurement system relates to critical activities in two ways: it picks up critical activities from plans and

specifications and absorbs them into work-package work descriptions, and it provides for auditing or tracking of the performance of the critical activities.

A. The Acquisition Process

1. The NASA System. Within the last two years there have been a number of changes in the acquisition process for the purpose of streamlining it and making it more cost effective. The current approach to the selection of contractors and negotiation of the contracts is significant to safety management, and it is necessary that the safety requirements and inputs be consistent with and comply with the intent of official NASA policy. See References 5 through 8. These changes largely have come about because of Mr. McCurdy's management study of the NASA acquisition process.

The McCurdy Report made significant recommendations to simplify the process of acquisition and to make it less expensive for the contractor by tailoring the requirements to eliminate excess or premature documentation in contractor proposals. Consequently, certain changes were made in the way of doing business for safety (also for quality assurance and reliability). The study recognized that safety, quality assurance, and reliability are not true discriminators in the contractor selection process, and that project plans for these activities should not be required until after a contractor is selected.

The specific statements in this report that concern safety are germane to this approach in meeting safety objectives, and they have been extracted and itemized in Table 1. Even though quality, reliability, and safety are not major discriminators in the selection process, they are important factors in each development program. Therefore, they must be itemized by tasks and included as part of the cost proposal. This inclusion in the cost proposal provides a significant indication to the Source Evaluation Board of the contractor's understanding of the assurance disciplines. As a cost saver, consideration will be given to the maximum use of the contractor's existing system for these functions, modified to satisfy unique project needs. The safety plan will be presented prior to the time of contract negotiation and the safety provisions will be negotiated at the time. See Reference 7, attachment A.

A further recommendation in Mr. McCurdy's report that directly affects project planning and acquisition and has an indirect effect on safety planning is that the approach to project planning will be adapted to accommodate the particular characteristics of each project. This is to say that the phasing in project planning is to be flexible and will not necessarily proceed

through rigidly predefined Phases A, B, C and D. This recommendation was implemented in the new project planning documents. See References 6 and 7.

In August of 1972, Procurement Regulation Directive PRD 72-12 was issued. See Reference 8. The recommendations concerning safety in the McCurdy report are incorporated in this directive. PRD 72-12 is a comprehensive document, with regard to treating safety in NASA contracting. Pertinent statements were extracted and are itemized for convenience in Table 2. Similarities with the statements in Table 1 are readily seen. The guidelines provided by PRD 72-12 are very useful in the acquisition process providing for an adequate safety program that is cost effective.

2. Safety Inputs. One of the very best opportunities that we have available to make appropriate safety inputs to enhance the project safety program is in the Request For Proposal document (RFP). The RFP includes the Statement of Work (S/W) and the Data Requirements List (DRL). These documents provide for the most effective timing and location of safety for these inputs, because they can assure that the contractor understands at the outset the NASA safety intent and requirements. With this initial understanding, later negotiation of safety into the contract will be simplified and should be at a minimum cost.

TABLE 1. MANAGEMENT STUDY OF THE NASA ACQUISITION PROCESS [5]

1. Reliability and quality assurance (R& QA) and safety must be considered during evaluation of proposal cost factors.
2. R and QA and safety are not major discriminators in contractor selection.
3. R and QA and safety will be set forth in separate segments of the RFP.
4. Documentation requirements for R and QA and safety will be limited to the extent necessary to satisfy evaluation and selection.
5. The bulk of the documentation, including R and QA and safety plans, etc., are to be submitted by the winners after selection.
6. Insofar as possible the contractor's existing safety system, if it is an effective one, will be used as is, or modified as required, to be acceptable for program needs.

TABLE 2. SAFETY EXTRACTS FROM PRD 72-12 [8]

1.	System safety is a factor which must be considered in each step of program development, project planning, and the procurement process.
2.	Special system safety requirements for major flight hardware systems will normally be prepared as an appendix to the S/W.
3.	System safety requirements in the RFP shall be treated prudently in proposal preparation and in the negotiation process so that an undue proposal preparation burden is not placed on offerors.
4.	Initial cost proposals shall include estimated man-hours and other costs associated with each major safety task as defined in the RFP.
5.	Offerors will provide a summary of the ultimate safety plan in their original proposal, indicating their understanding that a detailed plan is required after selection.
6.	Complete detailed system safety plans are submitted only by offerors selected for final contract negotiation.
7.	The offerors safety system or his safety program plan under a previous contract, providing it is an effective one, will be used as is or modified as required to meet program needs.

The RFP should provide for the proposer to describe his system of risk management, including how the project manager will be provided with adequate visibility of developing risks, in general, and safety risks, in particular, and how he will assure effective decision-making with regards to these risks. The contractor's program management plan should contain this type of information and information as to how the project will be organized to achieve an effective safety program. Other management plans in areas of engineering, manufacturing, testing, operation and logistics, etc., should contain sentences which may be only brief statements on meeting the safety objectives of systematic hazard identification and control in all areas of project activity.

The RFP should be designed to prompt each manager to give his personal testimony of his attitude concerning safety as it applies to his area of management. Well-placed sentences in pertinent locations in the RFP will enhance the contractors conciousness of safety needs and aid in his

understanding of how he can and must contribute to meeting NASA safety intentions for that project.

Specific safety data that is to be submitted by the contractor to the Government should be described clearly in Data Requirements Descriptions (DRD's), which become a part of the Data Requirements List. Requests for safety data submittals after a contract is negotiated require special unanticipated action by the contractor, and the cost of such submittals is often very high.

Responses to the RFP, S/W, and DRL in the form of the contractor's proposal, hardware and program specifications, and program plans should contain the contractor's approach toward achievement of an effective safety program. Statements of intention of meeting safety requirements with methods for achievement constitute recognition and proposed implementation of critical activities as defined above. As a matter of principle, safety inputs are not limited to the safety plan, but are dispersed throughout the system with safety provisions covered in all appropriate program documentation.

B. The Safety Plan

The contractor's safety plan describes his safety program. It includes the safety requirements that he will impose, the methods of analysis that he will use for hazard identification and for hazard control evaluation, his approach to meeting NASA imposed safety requirements, etc. The safety plan has come to be generally accepted as a required document in NASA as well as Department of Defense projects. Authorization and requirements for a safety plan are provided in the NASA Safety Manual and in Safety Program Directive 1A, References 1 and 9. Specifications for the preparation of a project safety plan are prepared in the form of a data requirements description to be included as part of the data requirements list.

Provision is made in PRD 72-12, Reference 8, for a summary of the ultimate safety plan to be included in the offeror's original proposal, indicating their understanding of the project's safety needs and that a detailed plan is required after selection. Provisions are also made that the initial cost proposals shall include estimated man-hours and other costs associated with each major safety task as defined in the RFP. See Table 2. The safety plan will be submitted after a contractor is selected and prior to negotiation of the contract. Although the ultimate plan is not submitted as a part of the proposal, the contractor must have a plan to serve the following purposes:

1. As a basis to prepare the cost proposal.

2. To make dispersed inputs into his basic function plans.

3. To prepare a summary safety plan as part of the proposal.

4. To be prepared to submit and negotiate a safety plan if he is selected.

The contractor's existing safety system or his safety plan under a previous contract, providing it is an effective one, will be used as is or modified to meet the needs of the project. See References 5 and 8. This is the most cost-effective approach to a contractor's safety program, and since the system is or has been in operation, the system is well understood by the contractor and is readily adaptable to the project at hand.

For the Space Shuttle program, NHB 5300.4(1D), Reference 10, has been issued to establish common safety, reliability, maintainability, and quality provisions for each project comprising the Shuttle program. The data presented in this document officially applies to Shuttle; however, it contains valuable information that should be beneficial to future programs as well.

C. The Safety Plan Summary

A safety summary will be submitted as part of the original contractor's proposal and will be reviewed in the evaluation and selection of a contractor. See References 5 and 8. This summary will identify safety tasks and provide the following information about each task. See Reference 10, paragraph 1D200-1.

1. Other program plans which are involved.

2. Contractor organization(s) involved in the execution of each task.

3. The contractor program procedure/instruction which describes how each task is performed.

4. The start and completion schedule of each task including the program schedule or milestone which the task supports.

5. The output products of each task, including identification of deliverable data.

6. The resources or man-hours required to execute each task.

It is preferable that the summary be submitted in the form of a matrix containing the list of safety tasks and the above requested information for the accomplishment of each task. A suggested form for this summary matrix is displayed in Table 3.

D. The Work Breakdown Structure

The appearance of safety will occur in more than one place in the Work Breakdown Structure (WBS). It is significant that safety should occupy a space in the management section, because safety is definitely a management function and responsibility. The performance of all safety tasks, however, will not necessarily be performed in the safety management area: most of the safety tasks are of a technical nature and will be performed as a function of a technical discipline. Therefore, safety tasks will also appear in the line organization parts of the WBS. WBS cost accounts will be established at levels appropriate to identification of safety tasks and functions for the initial cost proposal and subsequent cost reporting.

E. Interface Management

In the usual NASA project there are many interfaces, and management of these interfaces is the responsibility of the project manager. Interface management is a serious safety concern, since inadequate attention to interfaces can result in hazards to hardware, personnel, the ultimate operation of the system, and, finally, the space mission. Interfaces are classified with respect to organization and to hardware, and both types of interfaces must be managed to provide for smooth transition across interfaces with adequate communication and documentation to ensure that design inputs are incorporated and that hardware subsystems mesh together with proper alignment of the vital connecting components.

A controlled path of communications must be established with provisions for design inputs, results from trade studies, etc., to enter into the system of specifications, drawings, engineering change proposals, etc. The communications path should provide to management sufficient visibility and assurance that these communications are adequately documented and transmitted to the proper point of incorporation.

TABLE 3. SAFETY TASK SUMMARY

SAFETY TASK	PROGRAM PLANS INVOLVED	ORGANI-ZATIONS INVOLVED	PROCEDURE/ INSTRUC-TION	SCHEDULE OF START AND COM-PLETION	DELIVER-ABLE DATA	RESOURCES OR MANPOWER

SECTION V. INTEGRATION OF SAFETY

The concepts of safety integration throughout different areas of a project have already been touched on in this memorandum. Each technical or operational area is unique and has its own peculiar needs and requirements for safety planning and activities. Specific hazardous conditions and operations and their effective control require specialized analysis and supervision germane to the technical area involved.

Development or operational activities of a typical NASA project can be categorized into five general areas:

1. Project Management
2. Engineering
3. Manufacturing
4. Testing
5. Product Support or Logistics

Safety must be effectively and appropriately treated in the planning and control of each of these activities and/or in activities subsidiary thereto, wherever expertise can be brought to bear to make contributions to systematic hazard identification and control.

Central to NASA project management are the required contractor's basic function plans. Practically all NASA programs will require a management plan for each of the five functional areas listed above, plus subplans as appropriate for functional activities subsidiary to the five basic plans. The key to effectively integrating safety in a project is to ensure that safety emphasis reaches into all areas of concern. To this end, each management plan must contain a segment addressing safety. These safety inputs into program plans and into specifications exemplify the critical activity system in which critical activities (including appropriate subactivities and techniques) that are to be implemented and monitored through the system of management are identified. Each segment on safety will highlight specific needs and requirements and will state provisions and precautionary activities to assure that personnel and property are not subjected to uncontrolled hazardous conditions. Hazards associated with specific activities will be identified through a logical analysis process, and the management plan or subplan will anticipate hazardous operations and should provide for precautionary measures, safety clauses in procedures at appropriate paragraphs, proof testing of handling equipment, etc.

One central safety plan may not adequately cover all of the detailed hazard identification and control activities that must be carried out in the various functional areas of the program; however, it should summarize the safety information contained in the safety segments of the other functional management plans.

To summarize integration of safety activities, each functional manager should analyze his area for opportunities to contribute to safety achievement. Reflection of these opportunities and his approach to taking action on them should be included in his functional plan.

SECTION VI. SAFETY INPUTS INTO PROGRAM PLANS

The previous section emphasized the importance of assuring integration of safety in the many project areas by the inclusion of statements on safety in the pertinent management plans. This applies to the five basic program plans as follows:

1. Program Management Plan
2. Engineering Management Plan
3. Manufacturing Management Plan
4. Integrated Test Management Plan
5. Product Support (Logistics) Management Plan.

This also applies to appropriate subplans to the above such as the Configuration Management Plan, the Technical Performance Measurement Plan, the Work Breakdown Structure, and others.

The method recommended for instructing or communicating to the contractor our requirement for his inclusion of appropriate safety inputs into his program plans is through the use of experience-retention checklists. The preparation of such checklists is based on previous experience gained from other programs, technology documents/specifications, and personal thought and inventiveness. The use of the experience-retention checklist is a valuable tool in the hands of the project manager, both in government and in the contractor's plant. The implementation of safety checklists is illustrated in Figure 1, where the proposed checklists are made available to the project manager, who includes them in the RFP or S/W. The checklist information is then reflected in the contractor's proposal and in the final negotiated program plans.

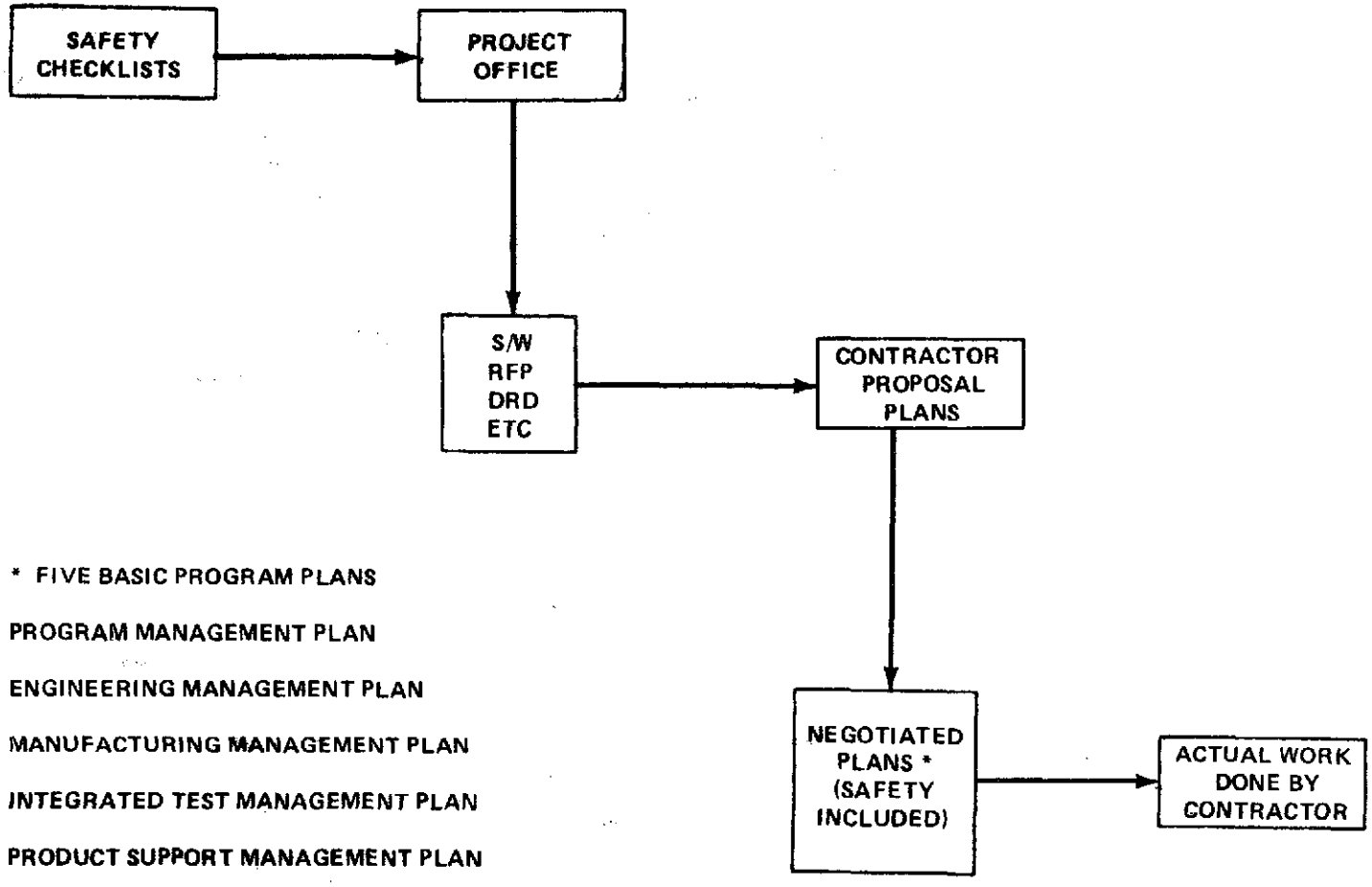

Figure 1. Safety via experience retention checklists.

Cursory checklists have been prepared by the MSFC Safety and Manned Flight Awareness Office to illustrate their use in building safety awareness and activities into certain of the program plans. These checklists are presented in the following paragraphs as typical and illustrative of the types of information that should be included. Safety checklists are most effectively utilized when they are tailored to the needs of the specific program. They should also be candid and to the point.

A. Program Management Plan Checklist

The Program Management Plan shall contain the following information:

1. Company policy and practices in their safety and motivation programs.

2. Safety organization and how the program manager uses his safety organization and how it interfaces with other program elements.

3. Collection and use of safety analyses and tasks; e.g., risk management summary information.

4. Procedure for feedback and use of information from problems experienced in the program and from other programs.

5. Appropriate inclusion of safety in all management systems; e.g., work breakdown structure, cost schedule performance criteria, etc.

6. Assessment of risks and hazards affecting the safety of the system to be included in program reviews.

7. How the motivational program meets the intent of NPD 1700.3A, dated March 24, 1972 [11].

B. Engineering Management Plan Checklist

The Engineering Management Plan shall contain a segment devoted to a discussion of safety as it applies in the area of engineering, including the following information.

1. Identification of methods used for identification and analysis of hazards.

2. Procedure for feedback and utilization of information gained from problem solving in this and other programs.

3. Provisions for identifying and compiling safety design criteria.

4. Provisions for integration and communication of safety requirements and criteria with other operating functions, such as manufacturing, test, etc.

C. Manufacturing Management Plan Checklist

The Manufacturing Management Plan shall contain a segment devoted to a discussion of safety as it applies in the area of manufacturing, including the following information:

1. Provisions for caution and warning notes to be placed in procedures involving hazardous operations. Caution notes are to be placed in the procedure immediately preceding each hazardous step in the operation.

2. Provisions for testing and certifying handling equipment used in handling and moving critical hardware.

3. Provisions for adequate planning and care in handling and moving hardware such as requiring the presence of a supervisor during handling.

4. Identification of the employee motivational program as implemented in the manufacturing division.

D. Integrated Test Management Plan Checklist

The Integrated Test Management Plan shall contain a segment devoted to a discussion of safety as it applies in the area of test and checkout, including the following information.

1. Identification of the personnel certification procedure in compliance with MMI 1710.6, MSFC Program for Personnel Certification [12].

2. Provisions for caution and warning notes to be placed in procedures involving hazardous operations. Caution notes are to be placed in the procedure immediately preceding each hazardous step in the operation.

3. Provisions for training of personnel to ensure competency and safety in the operation.

4. Provisions for public safety and environmental considerations.

E. Product Support Plan Checklist

The Product Support Management Plan is unique among plans because it is operative and functional long after development and testing of hardware; therefore, it must be complete and self-contained and will overlap the development plans. This plan shall contain the following information. (The basic principals of packaging, handling, and transportation of aeronautical and space systems, equipment, and associated components are provided in Reference 14.)

1. The Product Support Management Plan should contain a complete section on safety as pertains to logistics activities.

2. For recoverable items, e.g., the Solid Rocket Booster of the Shuttle system, the quality control of the refurbishment process must be adequate for the achievement of safety.

3. Provisions for testing and certifying handling equipment used in handling or moving critical hardware.

4. Provisions for adequate planning and supervision for handling and moving hardware [14].

5. Provisions for adequate protection of hardware during storage, including maintaining a proper controlled environment.

F. Work Breakdown Structure Checklist

The Work Breakdown Structure shall identify safety tasks under management and in the technical disciplines with consideration for the following:

1. Safety tasks are identified in the work breakdown structure.

2. Safety tasks are identified under the management function; i.e., assurance management.

    a. A safety segment is contained in the program management plan and in appropriate subplans.

b. Integration of the safety segments in the engineering, manufacturing, logistics, etc., plan and/or subplans.

3. Safety tasks are identified under the engineering functions; system safety engineering.

   a. System Safety Program Plan

   b. Hazard Analysis

   c. Project Hazards Summary Report

4. Safety tasks are identified to provide safety segments in the following program plans:

   a. Program Management Plan

   b. Engineering Management Plan

   c. Manufacturing Management Plan

   d. Integrated Test Management Plan

   e. Product Support Management Plan

G. Configuration Management Plan Checklist

The Configuration Management Plan shall contain statements on the application of safety principles pertaining to configuration management. The following information shall be included:

1. CEI log books should be maintained as a part of the acceptance data package (IV-13)*.

2. The CEI log books should contain a summary of hazards that have been identified in the configuration management process.

3. Each engineering change proposal is reviewed to assure that safety of the system is not eroded by the proposed change (VI-1).*

* References in parentheses designate page numbers in "Standard Contractor Configuration Management Requirements, MSFC Programs", MM 8040.12, July 28, 1971, which is Reference 13 in the list of references in this report.

4. During regular periodic quality control inspections, safety should be surveyed at the same time by a QC representative or a safety representative (VII-3).*

5. General interface requirements will be specified concerning performance and physical characteristics for reliability, maintainability, operational availability, safety, environment, transportability, portability, and storage common to the interface elements (IX-16).*

6. The safety of the system should be assessed during formal reviews, inspections and demonstrations (X-1).*

SECTION VII. RECOMMENDATIONS

From this study of the role of project management in safety the following recommendations are made in the interest of attaining and integrating cost-effective project safety programs.

Safety should be recognized as a management function as well as a technical discipline.

The project manager should make safety a vital part of his planning activities.

Basic functional program plans should contain a statement devoted to the safety needs of that project area and how these needs are to be satisfied.

Safety activities should not be confined to a central safety function, but should be a viable activity in all appropriate project areas.

Safety functions should be included in the WBS to assure funding of safety assurance and safety engineering.

The critical activity system should be used as the tool for making appropriate safety inputs for effective integration and accomplishment of safety objectives.

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* References in parentheses designate page numbers in "Standard Contractor Configuration Management Requirements, MSFC Programs," MM 8040.12, July 28, 1971, which is Reference 13 in the list of references in this report.

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APPROVAL

THE PROJECT MANAGEMENT ROLE IN SAFETY

By R. C. Callaway

The information in this report has been reviewed for security classification. Review of any information concerning Department of Defense or Atomic Energy Commission programs has been made by the MSFC Security Classification Officer. This report, in its entirety, has been determined to be unclassified.

This document has been reviewed and approved for technical accuracy.

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